SPECIFICATION

TO ALL WHOM IT MAY CONCERN:

        BE IT KNOWN THAT WE, Takashi Koshimizu, a
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Kamakura-shi, Kanagawa 248-0007 Japan have invented certain
new and useful improvements in

      A CONTROL METHOD AND SYSTEM FOR INFORMATION DELIVERY
      THROUGH MOBILE COMMUNICATIONS NETWORK

Of which the following is a specification:-

TITLE OF THE INVENTION
A CONTROL METHOD AND SYSTEM FOR INFORMATION DELIVERY
THROUGH MOBILE COMMUNICATIONS NETWORK

5   BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a control
method and a control system for delivering information to
mobile terminal through mobile communication network. The
10   present invention further relates to an information
storage method which is performed at each node in the
mobile communication network where information is
delivered in accordance with the control method.

15   2. Description of the Related Art

A control method for delivering information
using the cache function of the fixed communication
network is defined in the standards, RFC2186 (Internet
Cache Protocol, Version 2) and RFC2187 (Application of
20   Internet Cache Protocol, Version 2). In the mobile
communication network where the control method for
delivering information complying with the standards, the
existence of a cache node along the route through which
data is transferred is checked before a mobile terminal
25   downloads the data. If a cache node exists in the delivery
channel, the information delivery is performed through the
cache node.

A communication system in which the
information delivery is performed in compliance with the
30   control method for delivering information to fixed
terminals are configured as shown in Fig. 1, for example.
The Internet Cache Protocol is utilized as the control
method for delivering information.

In Fig. 1, the communication network
includes communication nodes N1-N6 each functioning as a
router and communication nodes 21, 22, 31, and 41 each
functioning as a router and a cache (hereinafter referred
5   to as "cache nodes"). The local cache node 21 (LC-1) is
connected to the parent cache node 31 (PC-1) through the
communication node N3 and the subsidiary cache node 22
(SC-1) through the communication node N2. The parent cache
node 31 is connected to the grand parent cache node 41
10   (GC-1) through the communication nodes N4 and N5. The
grand parent cache node 41 is connected to the internet
INT where a host server 50 (SVR) exists, through the
communication node N6.

Client terminals 10_1(C1), 10_2(C2), 10_3(C3) are
15   connected to the local cache node 21 through the
communication node N1. They receive information delivery
service from the communication network where the local
cache node 21, the parent cache node 31, and the grand
parent cache node 41 each having a cache function are
20   arranged in a hierarchy.

In the network system described above,
information "D" stored in the host server SVR is
transferred to the client terminal 10_1(C1), for example,
in the following manner.

25   A request for delivery of the information D
sent by the client terminal 10_1 is transferred to the
local cache node 21 through the communication node N1. The
local cache node 21 checks whether it stores the
information D, and if it does not store the information D,
30   it transfers the request for delivery toward the
communication node N3. In response to the reception of the
request for the delivery, the parent cache node 31 checks
whether it stores the information D, and if it does not

store the information D, it further transfers the request
for delivery toward the communication node N4. The request
for delivery is transferred to the grand parent node 41
through the communication nodes N4 and N5. As described

5 above, if no cache node stores the information D which is
requested by the client 10_1, the request for delivery is
transferred to the communication nodes (including cache
nodes) sequentially.

      The request for delivery of the information

10 D is finally transferred to the host server 50 in the
internet INT. The host server 50 delivers the information
D toward the client terminal 10_1 through the internet INT.
The information D delivered by the host server 50 is
delivered to the client terminal 10_1 through each

15 communication nodes (including cache nodes).

      As shown in Fig. 2, in the process in which
the information D is delivered from the host server 50 to
the client terminal 10_1, the cache nodes, the local cache
node 21 and the parent cache node 31 for example, near the

20 client terminal 10_1 stores (or caches) cache information
D' identical to the information D.

      If one of the client terminals 10_1, 10_2, 10_3
issues another request for delivery of the information D,
the cache information D' corresponding to the information

25 D stored in the local cache node 21 is delivered to the
client terminal requested for the delivery. Accordingly,
the traffic within the communication network is reduced.

      Mobile terminals, however, move while
receiving the delivery of information, that is,

30 downloading data. Therefore, it is necessary to switch
delivery channel while receiving information. Since the
switching of the communication channel degrades the
efficiency of information delivery, it is not practical to

apply the abovementioned method for delivering information complying with the Internet Cache Protocol designed for the fixed communication network to the mobile communication network. For example, while receiving the delivery of cache information from a cache node in the mobile communication network, a mobile terminal, as it moves, switches its connection to cache nodes. That is, the delivery channel between the mobile terminal and the host server is switched. If a new delivery channel does not include a cache node which stores cache information, the cache function of the cache nodes do not work effectively.

SUMMARY OF THE INVENTION

Accordingly, it is the first object of the present invention to provide a novel and useful control method and control system for delivery information in which information is efficiently delivered to mobile terminals through the mobile communication network.

The second object of the present invention is to provide an information storage method for communication nodes in the mobile communication network to which the control method for delivering information is applied.

In order to achieve the above objects according to the present invention, a control method for information delivery for a mobile communications network including a plurality of communication nodes, includes a step of identifying a first cache node storing cache information in a first delivery channel established in response to a delivery request for original information from a mobile terminal staying in a first communication area, wherein said cache information is identical to said

original information, a step of identifying a second cache
node storing cache information in a second delivery
channel while said mobile terminal is receiving said cache
information from said first cache node through said first
5 delivery channel, a step of sending by said first cache
node to said second cache node a first signal indicating
that a portion of said cache information has been
delivered to said mobile terminal by said first cache node,
and a step of delivering said cache information except for
10 said portion of said cache information in response to said
first signal from said second cache node to said mobile
terminal in a second communication area.

        In the control method for information
delivery, as the mobile terminal which receives the cache
15 information from the first cache node through the first
delivery channel moves, when the first delivery channel is
switched to the second delivery channel, the second cache
node storing the cache information in a second delivery
channel delivers the remaining portion of the cache
20 information to the mobile terminal through the second
delivery channel.

        In order to realize a continuous efficient
delivery of the cache information, the present invention
is characterized by the control method described above,
25 further including a step of informing, by said first cache
node, a third cache node that said portion of said cache
information has been delivered to said mobile terminal,
and a step of informing, by said third cache node, a
second cache node that said portion of said cache
30 information has been delivered to said mobile terminal
through said first delivery channel, wherein said third
cache node is included in both said first delivery channel
and said second delivery channel.

The present invention further includes the
control method described above, wherein the second
delivery channel is established, and the second cache node
in the second delivery channel is identified when the
5 mobile terminal performs a hand-over to another wireless
communication node while the mobile terminal receives the
cache information from the first cache node through the
first delivery channel.

To achieve the first object, the present
10 invention further includes a control system for
information delivery for a mobile communications network
including a plurality of communication nodes, including
means for identifying a first cache node storing cache
information in a first delivery channel established in
15 response to a delivery request for original information
from a mobile terminal staying in a first communication
area, wherein said cache information is identical to said
original information, means for identifying a second cache
node storing cache information in a second delivery
20 channel while said mobile terminal is receiving said cache
information from said first cache node through said first
delivery channel, means for sending to said second cache
node a first signal indicating that a portion of said
cache information has been delivered to said mobile
25 terminal by said first cache node, and means for
delivering said cache information except for said portion
of said cache information in response to said first signal
from said second cache node to said mobile terminal in
said second communication area.

30 Furthermore, to achieve the second object,
the present invention includes an information storage
method for a first cache node in a mobile communications
network in which a mobile terminal receives information

through a plurality of delivery channels while said mobile
terminal moves from a communication area to another,
wherein a portion of said information which is transferred
through said first cache node is stored in said
5   communication node. .

In this information storage method, in the
process that the cache information is delivered to the
mobile terminal, portions of the cache information are
stored in each communication node in the mobile
10   communications network. If another mobile terminal
requests for the delivery of the information under the
circumstances where the portions of the cache information
are stored in each communication node, the portions of the
cache information are to be delivered from each
15   communication node to the mobile terminal.

The present invention is further configured
to an information storage method described above in which
said first cache node manages said portion of said
information using a stored data control table indicating
20   the title of said information and the identification
information of said portion of said information.

The present invention is also configured to
an information storage method described above in which, if
said first cache node storing said portion of said cache
25   information therein is included in a delivery channel
which is established in response to an information
delivery request, said first cache node delivers said
portion of said cache information to said mobile terminal.

In a mobile communications network utilizing
30   this control method for information delivery, a portion of
the information relative to the information delivery
request from the mobile terminal is delivered from the
first cache node to the mobile terminal. Accordingly the

volume of information transferred through the delivery
channel in the mobile communications network can be
reduced.

5 The present invention is yet further
configured to a control method of information delivery as
described above in which, if a second cache node is
included in the delivery channel established as described
above, the first cache node informs the second cache node
that the first cache node finishes delivering the portion
10 of the cache information, and the second cache node
delivers the remaining portion of the cache information,
except for the portion already delivered by the first
cache node, to the mobile terminal through the delivery
channel in order to deliver the requested information to
15 the mobile terminal more efficiently.

Furthermore, the present invention is
configured to a control system for information delivery
described above which controls the information delivery to
the mobile terminal through a mobile communications
20 network including cache nodes storing portions of the
information in accordance with the abovementioned control
method for information delivery, if the first cache node
storing the portion of the cache information relative to
the information delivery request is included in the
25 delivery channel established in response to the
information delivery request, the first cache node
delivers the portion relative to the information delivery
request to the mobile terminal.

Other objects, features, and advantages of
30 the present invention will be more apparent from the
following detailed description when read in conjunction
with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

        Fig. 1 is a schematic drawing showing a conventional fixed communication network system in which information delivery is controlled in accordance with the Internet Cache Protocol;

        Fig. 2 is a schematic drawing showing cache information stored in each node in the conventional fixed communication network system shown in Fig. 1;

        Fig. 3 is a schematic drawing showing a configuration of a mobile communication system in which information delivery is controlled by the control method relative to an embodiment of the present invention;

        Fig. 4 is a schematic drawing showing a mobile communication system, relative to the embodiment of the present invention, in which information delivery channel is switched as a mobile terminal moves;

        Fig. 5A, 5B, and 5C are schematic drawings of a stored data table relative to an embodiment of the present invention; and

        Fig. 6 is a block diagram of a communication node apparatus relative to an embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

        Fig. 3 shows a system in which information is delivered in accordance with the control method for delivering information relative to an embodiment of the present invention.

        In Fig. 3, a mobile communication network includes local cache nodes 21_1, 21_2, 21_3, 21_4, parent cache nodes 31_1, 31_2, 31_3, and grand parent cache node 40, each operating as a router and an information storage device. The local cache node 21_1 is connected to the parent cache

node 31_1 through a communication node N41. The local cache node 21_2 is connected to the parent cache node 31_1 through communication nodes N32 and N41. The local cache node 21_3 is connected to the parent cache node 31_2 through a

5 communication node N33. The local cache node 21_4 is connected to the parent cache node 31_3 through a communication node N34.

The parent cache node 31_1 is further connected to a communication node N71 through

10 communication nodes N51 and N61. Each of the parent cache nodes 31_2 and 31_3 is connected to a communication node N52. The communication node N52 is connected to the communication node N71 through communication nodes N62 and N72. The communication node N71 is further connected to

15 the grand parent cache node 40. The grand parent cache node 40 is connected to the internet including a host server 50 through a communication node N8.

A plurality of wireless base stations 11_{11}, 11_{12}, ..., 11_{1n} (BS) is connected to the local cache node

20 21_1 through communication nodes N11 and N21. A mobile terminal 15_1 (MT) receives the delivery of information (packets) through the mobile communication network described above by wireless communicating with one of the wireless base stations.

25 The host server 50 in the internet INT stores information D. It is assumed that the grand parent cache node 40, the parent cache node 31_1, and the local cache node 21_3 in the mobile communication network have already stored cache information D'.

30 When the mobile terminal 15_2 is turned on, while staying in the communication area of the wireless base station 11_{2m}, or enters the communication area of the wireless base station 11_{2m}, the wireless base station 11_{2m}

recognizes that the mobile terminal 15_2 is in its communication area, and establishes a default delivery channel of information for the mobile terminal 15_2 in the following manner.

5   In response to the recognition that the mobile terminal 15_2 is in its communication area, the wireless base station 11_{2m} issues a registration request of the mobile terminal 15_2 together with, for example, its own identification such as its IP address toward the

10   communication node N12. The registration request is transferred through the communication nodes N12 and N22, the local cache node 21_2, the communication nodes N32 and N41, the parent cache node 31_1, the communication nodes N51, N61, N71, the grand parent node 40, and the

15   communication node N8. During the process of transferring the registration request, each node (including cache nodes) registers itself as a member of the delivery channel for the mobile terminal 15_2 (entry). Accordingly, a default delivery channel ① is established for the

20   mobile terminal 15_2 in the mobile communication network.

          When the mobile terminal 15_2 issues a delivery request for information D toward the wireless base station 11_{2m}, the wireless base station 11_{2m} transfers the request serially through each communication nodes

25   (including cache nodes) in the delivery channel ① described above. In the delivery process, each cache node checks whether it stores cache information D' relative to the information D, in response to the receipt of the delivery request. If the cache node does not store the

30   cache information D', the cache node further transfers the delivery request toward the upper communication nodes. If the cache node determines that it stores the cache information D', it determines that it becomes the delivery

source of the cache information D'.

For example, if the local cache node 21_2 finds, in response to the delivery request, that it does not store the cache information D' relative to the

5   information D, the local cache node 21_2 transfers the delivery request toward the communication node N32. The parent cache node 31_1 checks, in response to the receipt of the delivery request, whether it stores cache information D', and if the parent cache node 31_1 finds

10   that it stores the cache information D' therein, it determines that it becomes the delivery source of the cache information D'.

Accordingly, once the parent cache node 31_1 determines that it becomes the delivery source of the

15   cache information D', it transfers the cache information D' addressed to the mobile terminal 15_2 toward the communication node N41. The cache information D' is transferred to the wireless base station 11_{2m} which performs wireless communications with the mobile terminal

20   15_2 through the communication nodes N41 and N32, the local cache node 21_1, the communication nodes N41 and N32, the local cache node 21_1, the communication nodes N21 and N11, and finally delivered from the wireless base station 11_{2m} to the mobile terminal 15_2.

25   Under such situation, it is further assumed that the mobile terminal 15_2, while being delivered the cache information D' from the parent cache node 31_1, moves from the communication area of the wireless base station 11_{2m} to the communication area of the wireless base station

30   11_{31}.

The mobile terminal 15_2 sends a hand-over request. In response to the receipt of the hand-over request, the wireless base station 11_{2m} transfers the hand-

over request toward the communication node N12 next to the
wireless base station 11_{2m}. The hand-over request is
further transferred from the communication node N12
through each communication node (including cache nodes) in
5 the delivery channel ①. The parent cache node 31_1 which is
delivering the cache information D' stops the delivery of
the cache information D' in response to the receipt of the
hand-over request.

   The mobile terminal 15_2 sends the hand-over
10 request with the information which is contained in the
cache information D' to identify the original information
D to the wireless base station 11_{31}. In response to the
hand-over request, another default delivery channel ② is
newly established in the following manner.

15   The wireless base station 11_{31} receives the
hand-over request, and record (entry) that it becomes a
member of the delivery channel for the mobile terminal 15_2
after finding that it has no entry of the mobile terminal
15_2. The wireless base station 11_{31} next transfers the
20 hand-over request to the upper node, that is, the
communication node N13. The communication node N13 makes
the entry of the mobile terminal 15_2, and further
transfers the hand-over request to the upper node, that is
the communication node N23. In the same manner, the hand-
25 over request is transferred serially from the
communication node N23 through the local cache node 21_3,
the communication node N33, the parent cache node 31_2, the
communication nodes N52, N62, and N72, to the
communication node N71. During this process, each
30 communication node records (entry) that it became a member
of the delivery channel for the mobile terminal 15_2. Since
the communication node N71, however, has the entry of the
mobile terminal 15_2, it does not transfer the hand-over

request to the upper node. The communication node N71
recognizes that it is a common member of both delivery
channels before and after the hand-over, that is, the
diverging point of the two delivery channels.

5   When the communication node N71 finds that
it is the diverging point of the two delivery channels,
sends a control signal for eliminating the entry of the
mobile terminal 15_2 toward the communication node N61 in
the delivery channel ①. This control signal is

10   transferred to the wireless base station 11_{2m} serially
through the communication nodes N61 and N51, the parent
cache node 31_1, the communication nodes N41 and N32, the
local cache node 21_2, the communication nodes N22 and N12.
During this process, each communication node eliminates

15   the entry relative to the mobile terminal 15_2. That is,
the delivery channel ① for the mobile terminal 15_2 is
disengaged.

              As described above, once each communication
node finishes recording the entry relative to the mobile

20   terminal 15_2, a new delivery channel ② for the mobile
communication terminal 15_2 after the hand-over is
established in the mobile communication network.

              After the new delivery channel ② is
established, a delivery request for the cache information

25   D′ issued by the mobile terminal 15_2 is transferred from
the wireless base station 11_{31} which received the delivery
request from the mobile terminal 15_2 to the local cache
node 21_3 serially through the communication nodes N13 and
N23 in the delivery channel ②. The local cache node 21_3,

30   in response to the delivery request, checks that it stores
the cache information D′ therein, then informs the
communication node N33 next to the local cache node 21_3
that the local cache node 21_3 stores the cache information

D', and is the cache node near the mobile terminal 15_2 which originated the delivery request. The information is transferred from the communication node N33 up to the communication node N71, the diverging point of the old and

5   new delivery channels, through the parent cache server 31_2 and the communication nodes N52, N62, and N72, serially.

On the other hand, the parent cache node 31_1 which was the delivery source of the cache information D' before the hand-over sends control information indicating

10   that it stopped the delivery of the cache information D' because of the hand-over to the communication node N51. The information is transferred through the communication nodes N51 and N61 up to the communication node N71. The control information described above further indicates the

15   portion (sequence number) of the cache information D' delivered prior to the hand-over request from the mobile terminal 15_2 in addition to the information that the transfer of the cache information D' was interrupted by the hand-over.

20   The communication node N71, in response to the receipt of the above information, transfer the information about the delivered portion of the cache information D' to the local cache node 21_3, that is, the new delivery source of the cache information D'. The

25   information is transferred to the local cache node 21_3 through the communication nodes N72, N62, and N52, the parent cache node 31_2, and the communication node N33.

The local cache node 21_3, in response to the receipt of the information about the delivered portion of

30   the cache information D', delivers the remaining portion of the cache information D' to the mobile terminal 15_2. The remaining portion of the cache information D' is transferred through the communication nodes N23 and N13 to

the wireless base station 11_{31}, the destination of the
hand-over, in the delivery channel ②. It is further
transferred from the wireless base station 11_{31} to the
mobile terminal 15_2.

5   As described above, even if the mobile
terminal 15_2 is handed over to the wireless base station
11_{31} during the information delivery, the mobile terminal
15_2, which is receiving the cache information D' from the
parent cache node 31_1 through the communication nodes N41

10   and N32, the local cache node 21_1, the communication node
N22 and N12, and the wireless base station 11_{2m} in the
delivery channel ①, can continuously receive the
remaining portion of the cache information, after the
hand-over without issuing another delivery request for the

15   information D. Accordingly, the information delivery
control in the mobile communication network realizes
efficient information delivery with utilizing the cache
function of the communication nodes, and reduces
information traffic within the mobile communication

20   network.
          In the embodiment described above, it is
assumed that communication nodes (including cache nodes)
in the mobile communication network are connected in a
hierarchy (at least logically), but the control method for

25   delivering information is also applicable to a mobile
communication network in which communication nodes are
connected in a different manner such as meshed
configuration.
          In the mobile communication network in which

30   information delivery is controlled as described above,
each cache node stores information in the following manner.
          In the case that the mobile terminal 15 to
which information is delivered through the mobile

communication network where the information delivery is
controlled in the manner described above moves in a wide
range, as shown in Fig. 4, cache nodes serve the mobile
terminal 15 by turns, as the mobile terminal 15 moves in
5   the range, as a delivery source of the cache information.
In Fig. 4, common components to Fig. 3 are referred to by
the same numerals as in Fig. 3. The communication nodes
connected to the local cache nodes 21_1, 21_2, 21_3, 21_4 and
the wireless base stations under the local cache nodes are
10   omitted.

          While the mobile terminal 15 staying at a
position 1 receives the cache information D' from the
parent cache node 31_1 through the communication nodes N41
and N32 and the local cache node 21_2 (delivery channel ①),
15   the local cache node 21_2 stores the cache information D'
(packets) serially. After receipt of a portion d1 of the
cache information D', the mobile terminal 15 is assumed to
move from the position 1 to a position 2. Since the grand
parent cache node 40 starts serving, in accordance with
20   the control method for information delivery described
above, the mobile terminal 15 as a new delivery source of
the cache information D' after the move of the mobile
terminal 15, the parent cache node 31_1 stops sending the
cache information D' to the local cache node 21_2. The
25   local cache node 21_2 registers the storage of the portion
d1 of the cache information D' therein.

          The local cache node 21_2 registers the
storage using a stored data control table, shown in Fig.
5A for example, indicating information for identifying the
30   cache information D' (its name, for example) and
information for identifying the portion d1, such as
sequential numbers of stored packets (SN1 - SNn, for
example).

As the mobile terminal 15 moves to the position 2, the grand parent cache node 40 starts delivering the remaining portion of the cache information D' as the new delivery source of the cache information D'

5   in accordance with the procedure described above in reference with Fig. 3. Then, the remaining portion of the cache information D' is transferred to the mobile terminal 15 at the position 2 through communication nodes N71, N72, N62, and N52, the parent cache node 31_2, and the local

10   cache node 21_3 (delivery channel ②). The parent cache node 31_2 and the local cache node 21_3 store the cache information D', portion by portion, as they transfer the cache information D'.

         Furthermore, the mobile terminal 15 is

15   assumed to move from the position 2 to a position 3 after it receives portions d2 and d3 of the cache information D'. Due to this move, a new delivery channel of the cache information from the grand parent cache node 40 through the parent cache node 31_3 and the local cache node 21_4 is

20   established in accordance with the abovementioned control method for information delivery, and the parent cache node 31_2 and the local cache node 21_3 are disengaged from the delivery channel. Once the new delivery channel is established, the parent cache node 31_2 stops sending the

25   cache information D' to the local cache node 21_3. The local cache node 21_3 registers therein the portions d2 and d3 of the cache information D' which have been stored.

         As shown in Fig. 5B, the local cache node 21_3 maintains a stored data control table indicating the

30   relationship between the information to identify the cache information D' and the information (packet sequential numbers) to identify the stored portions d2 and d3 of the cache information D'.

The yet remaining portion of the cache
information D' is transferred from the grand parent cache
node 40 to the mobile terminal 15 through the newly
established, as the mobile terminal 15 moves to the
5   position 3, delivery channel including the parent cache
node 31_3 and the local cache node 21_4 (delivery channel ③).
The parent cache node 31_3 and the local cache node 21_4
transferring the cache information D' store the yet
remaining portions of the cache information D' portion by
10   portion.

It is further assumed that the delivery of
the cache information D' ends by the mobile terminal 15
receiving the portions d4 and d5 of the cache information
D'. Accordingly the mobile terminal 15 obtains the cache
15   data D' consisted of the portions d1, d2, d3, d4, and d5.
The parent cache node 31_3 and the local cache node 21_4
receive no more portion of the cache information D' to be
transferred because the portion d5 is the last portion.
The parent cache node 31_3 and the local cache node 21_4
20   register therein the portions d4 and d5 of the cache
information D' stored by the end of the transfer of the
cache information D'. For example, the stored data control
table registers the relationship of the information to
identify the cache information D' and the information to
25   identify the stored portion d4 and d5 (sequential numbers
of packets) as shown in Fig. 5C.

As described above, as the mobile terminal
15 moves from the position 1 to the position 3, the
delivery channel of the cache information D' is switched
30   in the mobile communication network, and the portions of
the cache information D' are stored by each cache node
through which each portion of the cache data is
transferred. Each cache node control the stored portions

of the cache information D' utilizing the stored data
control table shown in Figs. 5A, 5B, and 5C.

     If another mobile terminal at the position 2,
for example, requests for the delivery of the information

5 D after the end of the delivery of the cache information
D' to the mobile terminal 15, the information D is
transferred to the mobile terminal in the following manner.

     It is assumed here that the mobile terminal
15 issued another delivery request for the information D

10 for the ease of description. The delivery request for the
information D is transferred through the communication
nodes (including cache nodes) with establishing the
delivery channel ②. During the process, the local cache
node 21_3, in response to the receipt of the delivery

15 request of the information D, checks whether it stores the
cache information D' of the information D relative to the
delivery request. In reference to the stored data control
table (shown in Fig. 5B), the local cache node 21_3
determines that it stores the portions d2 and d3 of the

20 cache information D', and it transfers the information
with the delivery request from the mobile terminal 15 as
cache node information. The parent cache node 31_2
transfers, as cache node information, the information
indicating that the local cache node 21_3 stores the

25 portions d2 and d3 of the cache information D'. The grand
parent cache node 40 further transfers, as cache node
information, the information indicating that it stores
entire cache information D'.

     The grand parent cache node 40 which stores
30 entire cache information D' relative to the delivery
request from the mobile terminal 15 at the position 2,
based on the delivery request and the cache node
information, assigns the local cache node 21_3 as the

delivery source of the portions d2 and d3 of the cache
information D', and further assigns itself, that is, the
grand parent cache node 40, as the delivery source of the
remaining portions d1, d4, and d5 of the cache information
5   D'. Then, information indicating that the local cache node
21_3 is assigned as the delivery source of the portions d2
and d3 of the cache information D' is transferred from the
grand parent cache node 40 to the local cache node 21_3 as
a control signal. In response to the control signal, the
10   local cache node 21_3 serially transfers the portions d2
and d3 of the cache information D' to the mobile terminal
15 at the position 2. Accordingly, the portions d2 and d3
of the cache information D' are transferred from the local
cache node 21_3 to the mobile terminal 15 through each
15   communication node in the delivery channel ②.

   After the local cache node 21_3 finishes
transferring the portions d2 and d3, the local cache node
21_3 informs the grand parent cache node 40 that the local
cache node 21_3 finished transferring the portions d2 and
20   d3. The grand parent cache node 40, in response to the
information indicating the finish of delivery, delivers
the remaining portions d1, d4, and d5 of the cache
information D' to the mobile terminal 15 at the position 2
through the communication nodes N71, N72, N62, N52, the
25   parent cache node 31_2, the communication node N33, and the
local cache node 21_3 in the delivery channel ②.

   As described above, the cache information D'
consisted of the portions d1, d2, d3, d4, and d5 is
delivered from each cache node in the mobile communication
30   network to the mobile terminal 15. In the procedure
described above, the portions of the cache information D'
is delivered to the mobile terminal 15 in the order of d2,
d3, d1, d4, and d5. The mobile terminal 15 arranges the

portions in reference to a packet sequential number of
each portion into the order d1, d2, d3, d4, and d5.
Accordingly, the mobile terminal 15 obtains the requested
information D by reproducing the cache information D'

5   arranged in the order of d1, d2, d3, d4, and d5.

Because portions of the cache information D'
stored in the cache nodes in the delivery channel ② is
effectively used through the delivery control of the cache
information D' described above, only the portions d1, d4,

10   d5 are necessary to be transferred through the delivery
channel between the grand parent cache node 40 and the
local cache node 21₃. It is only the delivery channel
(including the wireless portion) between the local cache
node 21₃ and the mobile terminal 15 at the position 2 that

15   all portions d1, d2, d3, d4, and d5 of the cache
information D' are delivered through. Compared to the case
in which all portions of the cache information D' from the
grand cache node 40 to the mobile terminal 15 at the
position 2, information traffic in the mobile

20   communication network is effectively reduced.

In the case that, after the delivery of the
cache information D' to the mobile terminal 15, another
mobile terminal at the position 3 makes a delivery request
for the information D, each portion of the cache

25   information D' is delivered to the mobile terminal at the
position 3 in the same manner as the portions are
delivered to the mobile terminal at the position 2 as
described above. That is, the portions d4 and d5 from the
local cache node 21₄, the remaining portions d1, d2, and

30   d3 from the grand parent cache node 40 through the parent
cache node 31₃ and the local cache node 21₄ are delivered
to the mobile terminal 15 at the position 3. The mobile
terminal 15 arranges the delivered portions of the cache

information D' to reproduce the requested information D.

Accordingly, only portions d1, d2, and d3 of
the cache information D' are delivered through the
delivery channel between the grand cache node 40 and the
local cache node 21_4. It is only the delivery channel
(including wireless portion) between the local cache node
21_4 and the mobile terminal 15 at the position 3 that all
portions of the cache information D' are necessary to be
transferred through. Compared to the case in which all
portions of the cache information D' are delivered from
the grand parent cache node 40 to the mobile terminal at
the position 3, the information traffic in the mobile
communication network is reduced.

Fig. 6 is a block diagram of a communication
node apparatus 100 (including a cache node) relative to an
embodiment of the present invention described above.

A communication node apparatus 100 which
exchanges information with other communication node
apparatuses 104 and 105 in a mobile communications network,
includes a control register unit 102 which stores entry
data therein. If the control register unit 102 stores the
entry data therein, the communication node apparatus 100
is included in a delivery channel of information to the
mobile terminal. The communication node apparatus further
includes a network control unit 101 which, in response to
a hand-over request from a mobile terminal, stores entry
data of the mobile terminal in the control register unit
102 if the control register unit 102 does not store the
entry data of the mobile terminal. Through this process,
the communication node apparatus 100 joins the delivery
channel of information to the mobile terminal.

The communication node apparatus 100
described above, wherein the network control unit 101, if

the control register 102 stores the entry data of the
mobile terminal therein, sends to one of the other
communication node apparatuses, the communication node
apparatus 105 for example, an instruction, in response to
5   which the one of the network node apparatuses, that is,
the communication node apparatus 105 in this example,
deletes an entry data of the mobile terminal stored in a
control register unit thereof.

A cache node can be configured as the
10 communication node described above, further including a
cache data storage unit 103 which stores cache data
therein, wherein the network control unit 101, in response
to a delivery request for information from the mobile
terminal, if the cache data is identical to the requested
15 information, sends to a communication node apparatus a
first signal indicating that the cache data storage unit
103 stores the cache data therein, and the network control
unit 101, in response to a second signal from one of the
communication node apparatuses indicating that a portion
20 of the information has been sent to the mobile terminal,
sends a remaining portion of the cache data identical to
the information stored in the cache data storage unit.

In summary, according to the present
invention, when the delivery channel of the mobile
25 terminal which receives the cache information from the
first cache node through the first delivery channel is
switched to the second delivery channel, because the
second cache node in the second delivery channel continues
the delivery of the cache information, the information
30 transfer to a mobile terminal is performed in more
efficient manner utilizing the cache function of the
mobile communications network.

According to the present invention, in the

process where the requested information is delivered to
the mobile terminal, a portion of the information is
stored in each communication node in the mobile
communication network. Accordingly, if another mobile
5   terminal requests for the same information, each
communication node can deliver the portion of the
information to the mobile terminal.

　　　　　Furthermore, according to the present
invention, a control method and system for information
10   delivery in which information is delivered to a mobile
terminal efficiently through a mobile communications
network including each communication node storing a
portion of the information are realized.

　　　　　The preferred embodiments of the present
15   invention are described above. The present invention is
not limited to these embodiments, but various variations
and modifications may be made without departing from the
scope of the present invention.

　　　　　This patent application is based on Japanese
20   priority patent application No. 2001-006641 filed on
January 15, 2001, the entire contents of which are hereby
incorporated by reference.